FIG. 1A

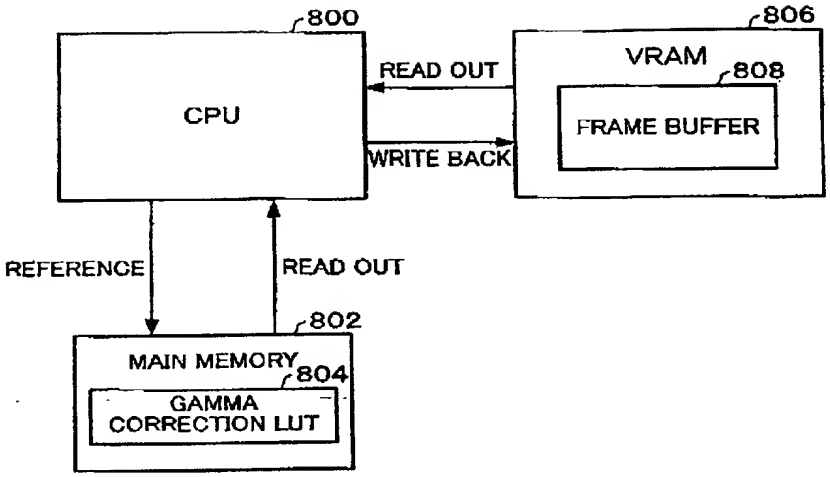
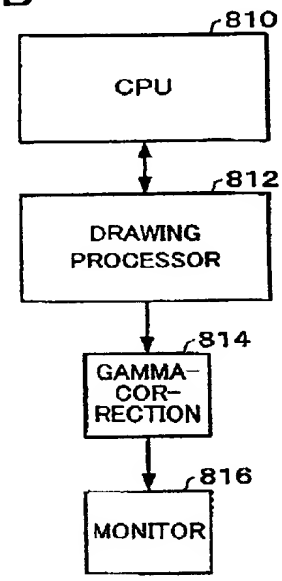
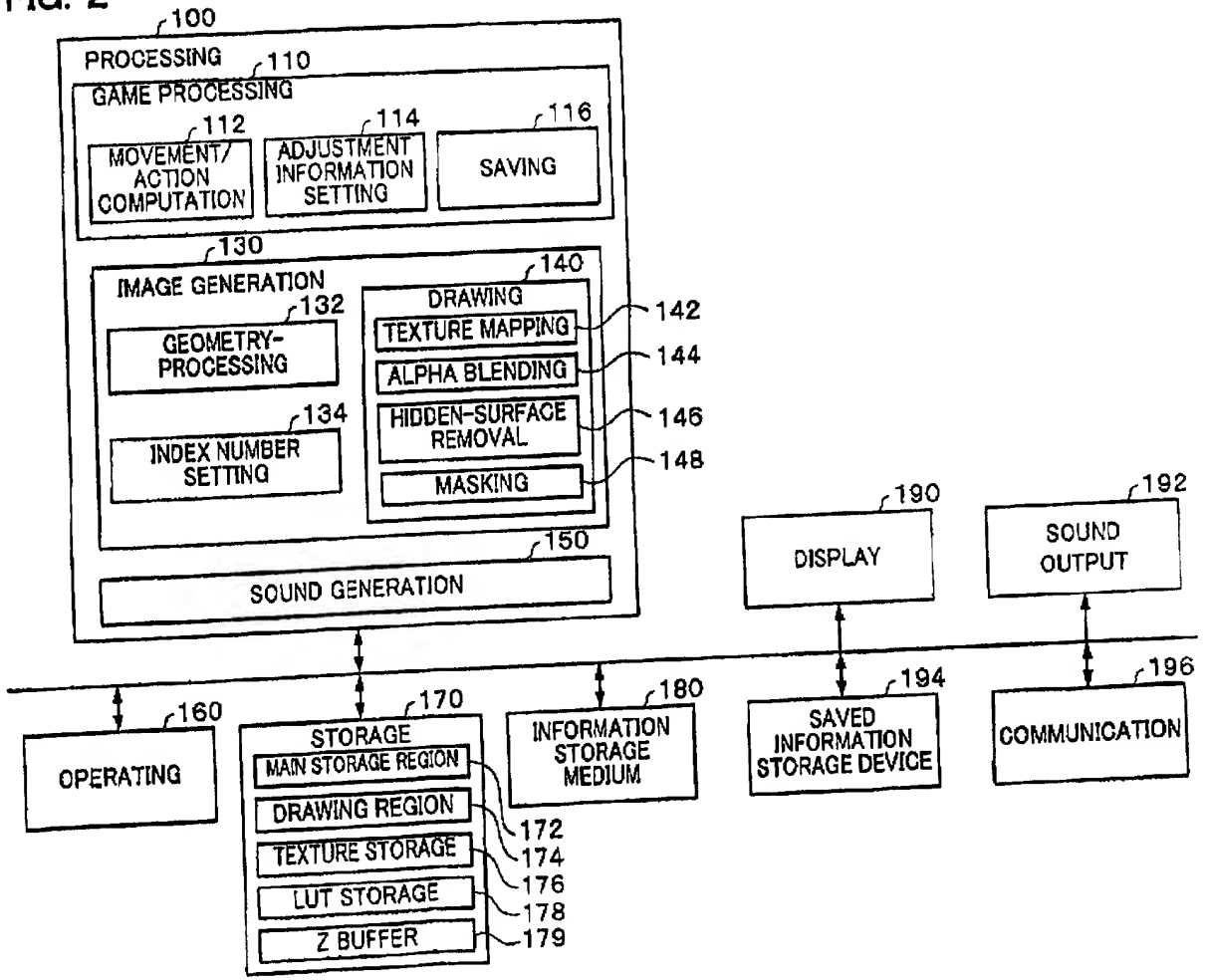

800
CPU
READ OUT
WRITE BACK
806
VRAM
808
FRAME BUFFER
REFERENCE
READ OUT
802
MAIN MEMORY
804
GAMMA CORRECTION LUT

FIG. 1B


810
CPU
812
DRAWING PROCESSOR
814
GAMMA-COR-RECTION
816
MONITOR

TOBTOT "EJSZE660

FIG. 2



09/937563

FIG. 3

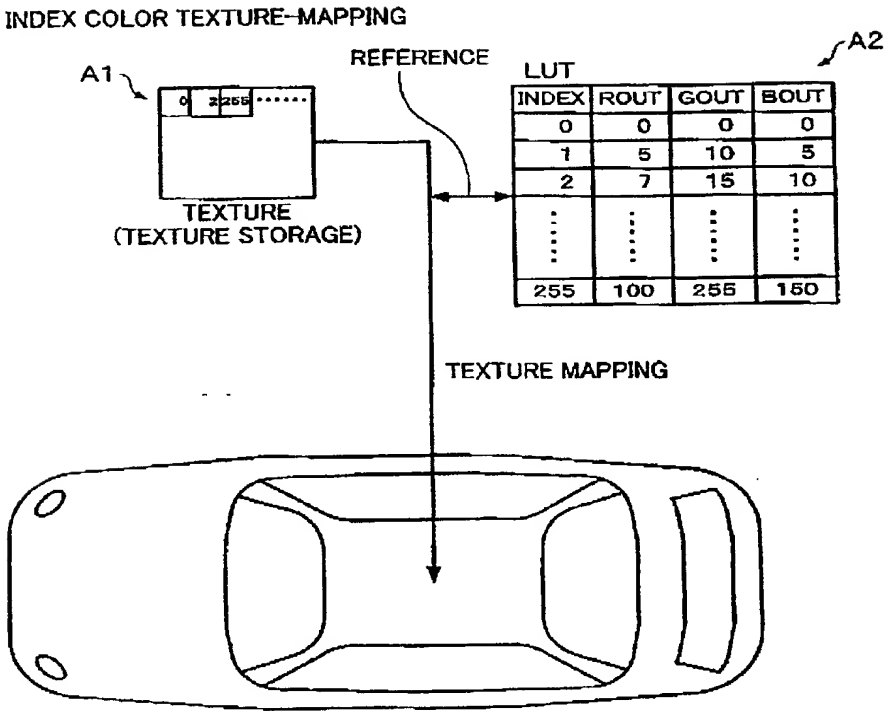

INDEX COLOR TEXTURE-MAPPING
A1
REFERENCE
LUT
A2
INDEX ROUT GOUT BOUT
0 0 0 0
1 5 10 5
2 7 15 10
255 100 255 150
TEXTURE
(TEXTURE STORAGE)
TEXTURE MAPPING

FIG. 4

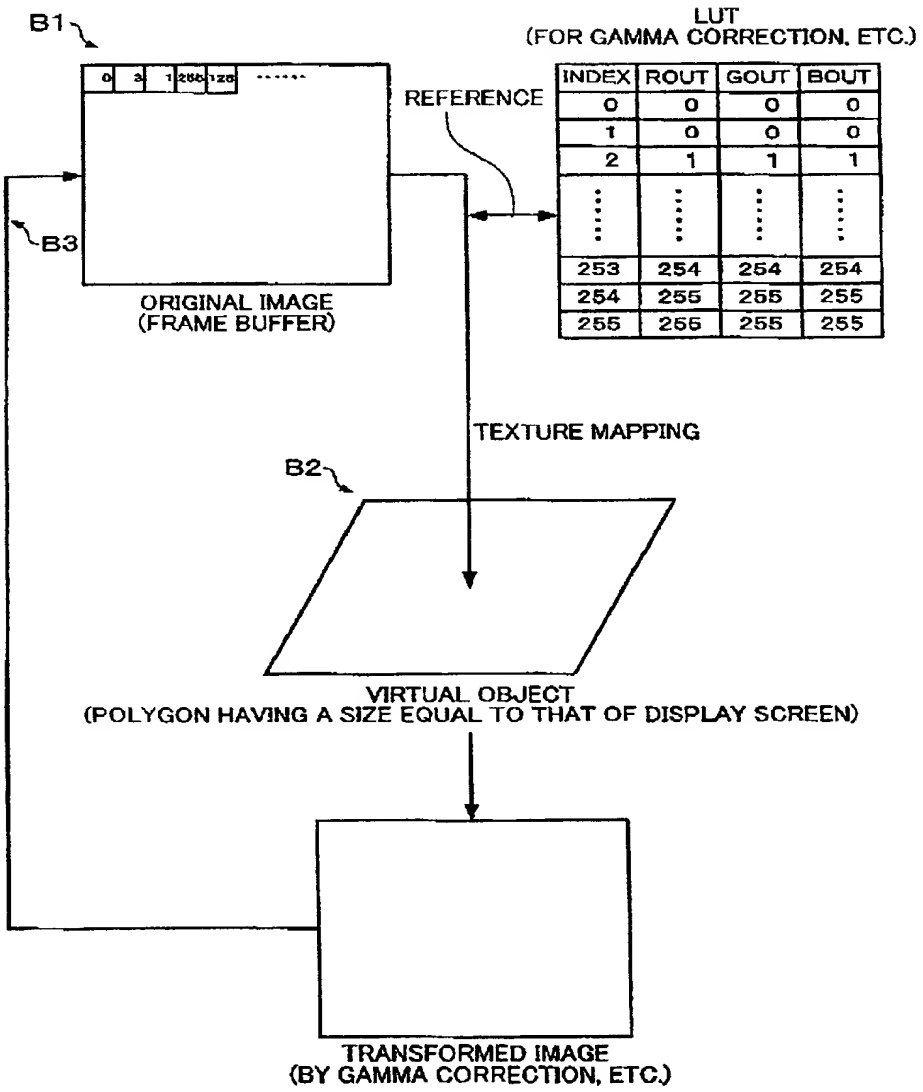

B1
LUT
(FOR GAMMA CORRECTION, ETC.)
REFERENCE
INDEX ROUT GOUT BOUT
0 0 0 0
1 0 0 0
2 1 1 1
253 254 254 254
254 255 255 255
255 255 255 255
B3
ORIGINAL IMAGE
(FRAME BUFFER)
TEXTURE MAPPING
B2
VIRTUAL OBJECT
(POLYGON HAVING A SIZE EQUAL TO THAT OF DISPLAY SCREEN)
TRANSFORMED IMAGE
(BY GAMMA CORRECTION, ETC.)

FIG. 5A

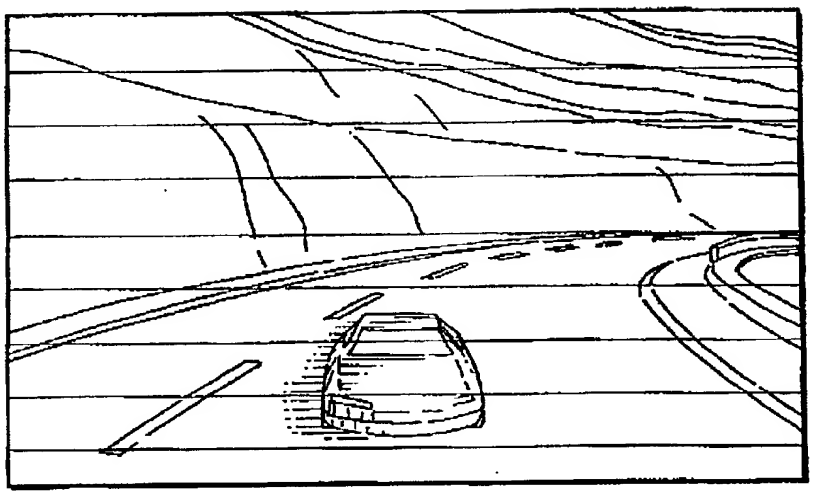
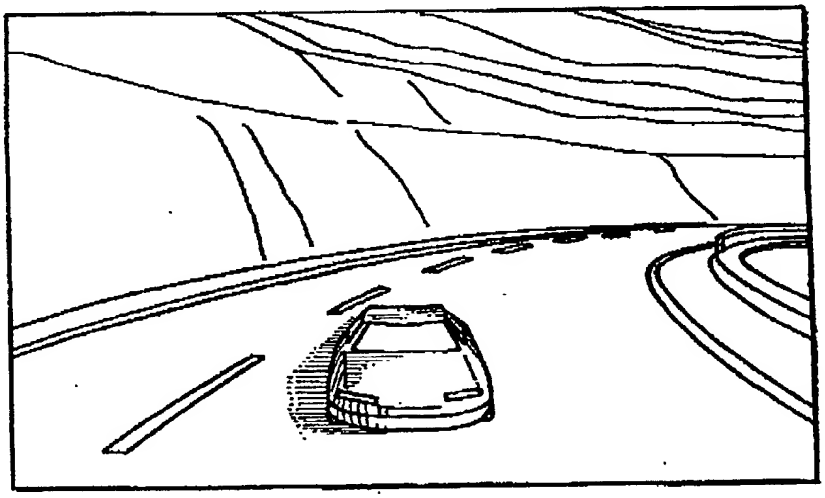


FIG. 5B



JP03TP1.20552650

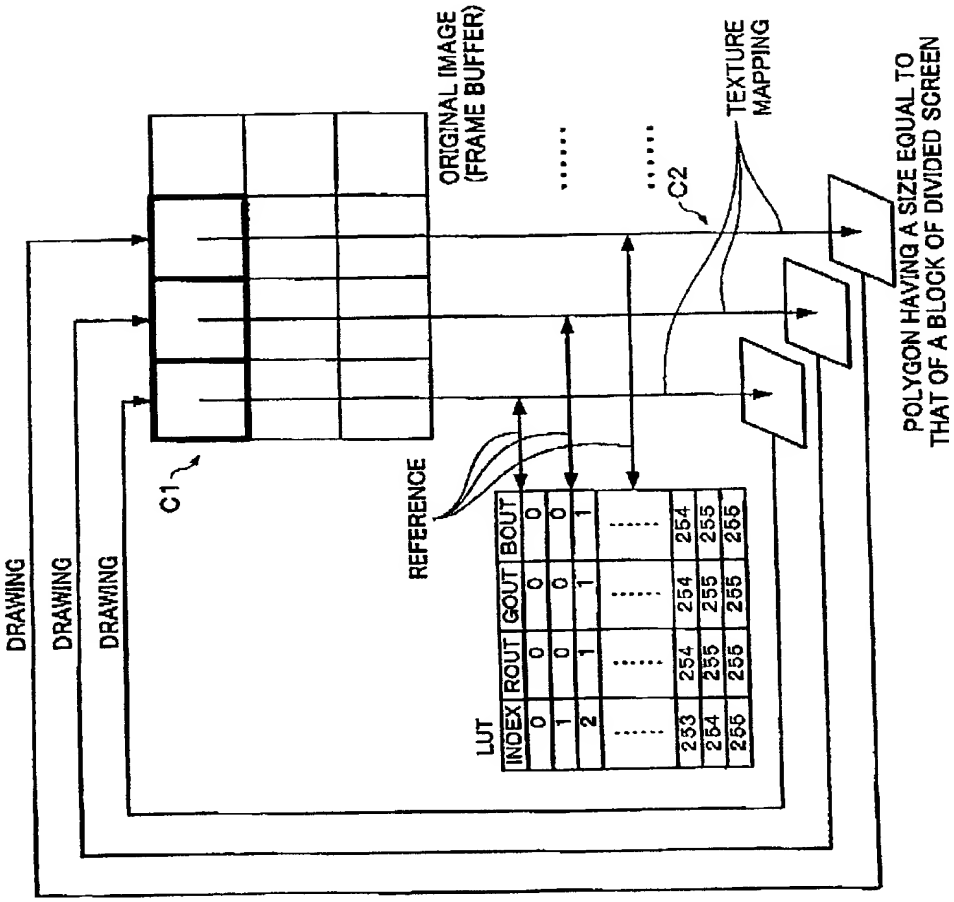

DRAWING
DRAWING
DRAWING
C1
ORIGINAL IMAGE
(FRAME BUFFER)
REFERENCE
LUT
INDEX ROUT GOUT BOUT
0 0 0 0
1 0 0 1
2 1 1 .....
233 254 254 254
254 255 255 255
255 255 255 255
C2
TEXTURE
MAPPING
POLYGON HAVING A SIZE EQUAL TO
THAT OF A BLOCK OF DIVIDED SCREEN

FIG. 6

FIG. 7A

GAMMA CORRECTION

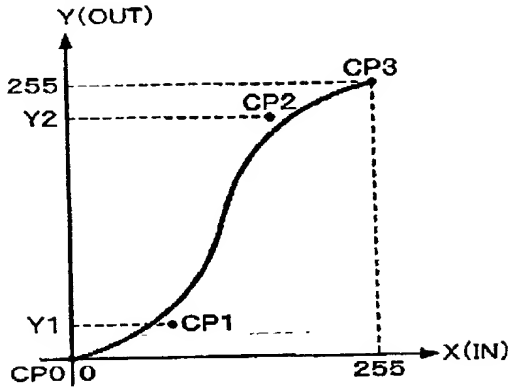


FIG. 7B

LUT FOR GAMMA CORRECTION

INDEX	ROUT	GOUT	BOUT
0	0	0	0
1	0	0	0
2	1	1	1
3	1	1	1
4	2	2	2
5	3	3	3
⋮	⋮	⋮	⋮
250	252	252	252
251	253	253	253
252	254	254	254
253	254	254	254
254	255	255	255
255	255	255	255

FIG. 8A

NEGATIVE/POSITIVE INVERSION

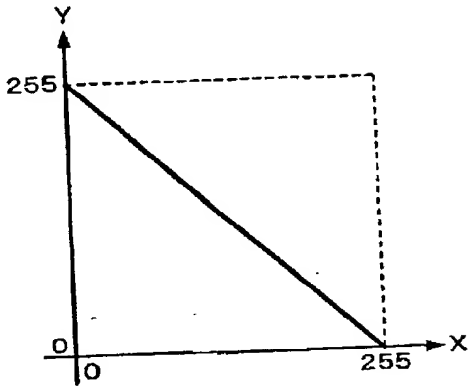


FIG. 8B

LUT FOR NEGATIVE/POSITIVE INVERSION

INDEX	ROUT	GOUT	BOUT
0	255	255	255
1	254	254	254
2	253	253	253
3	252	252	252
⋮	⋮	⋮	⋮
253	2	2	2
254	1	1	1
255	0	0	0

FIG. 9A POSTERIZATION

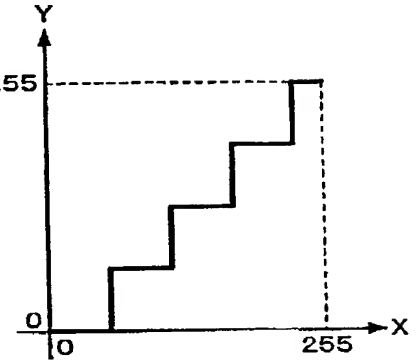


FIG. 9B SOLARIZATION

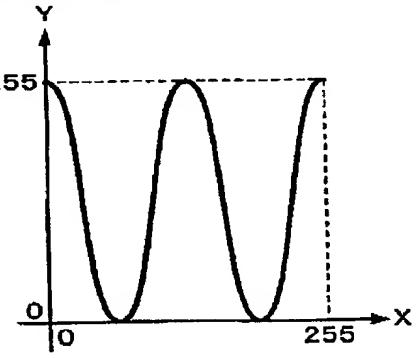
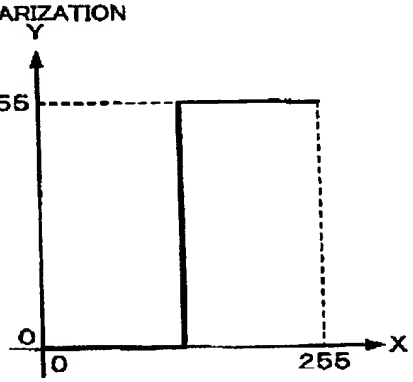


FIG. 9C BINARIZATION



FOSTER-255/2600

FIG. 10A

LUTR FOR MONOTONE FILTERING

INDEX	ROUTR	GOUTR	BOUTR
0	0	0	0
1	0	0	0
2	0	0	0
3	0	0	0
4	1	1	1
5	1	1	1
⋮	⋮	⋮	⋮
250	74	74	74
251	75	75	75
252	75	75	75
253	75	75	75
254	75	75	75
255	76	76	76

FIG. 10B

LUTG FOR MONOTONE FILTERING

INDEX	ROUTG	GOUTG	BOUTG
0	0	0	0
1	0	0	0
2	1	1	1
3	1	1	1
4	2	2	2
5	2	2	2
⋮	⋮	⋮	⋮
250	146	146	146
251	147	147	147
252	147	147	147
253	148	148	148
254	148	148	148
255	149	149	149

TOSHIBA 2555260

FIG. 11

LUTB FOR MONOTONE FILTERING

INDEX	ROUTB	GOUTB	BOUTB
0	0	0	0
1	0	0	0
2	0	0	0
3	0	0	0
4	0	0	0
5	0	0	0
⋮	⋮	⋮	⋮
250	28	28	28
251	28	28	28
252	28	28	28
253	28	28	28
254	29	29	29
255	29	29	29

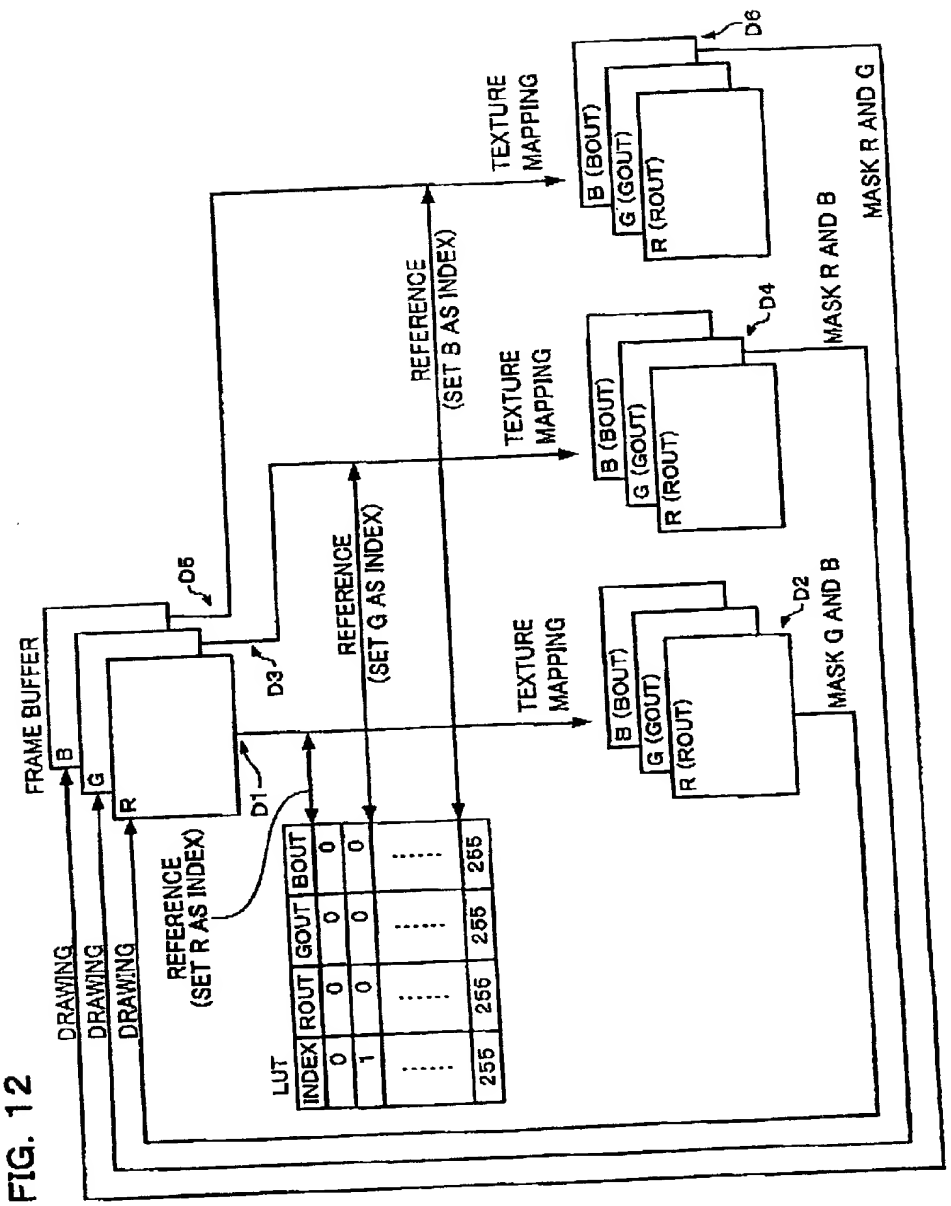

FRAME BUFFER
B
G
R
DRAWING
DRAWING
DRAWING
REFERENCE (SET R AS INDEX)
D1
D3
D5
REFERENCE (SET G AS INDEX)
REFERENCE (SET B AS INDEX)
LUT
INDEX ROUT GOUT BOUT
0 0 0 0
1 0 0 0
255 255 255 255
TEXTURE MAPPING
TEXTURE MAPPING
TEXTURE MAPPING
D2
D4
D6
B (BOUT)
G (GOUT)
R (ROUT)
MASK G AND B
MASK R AND B
MASK R AND G

FIG. 12

FIG. 13

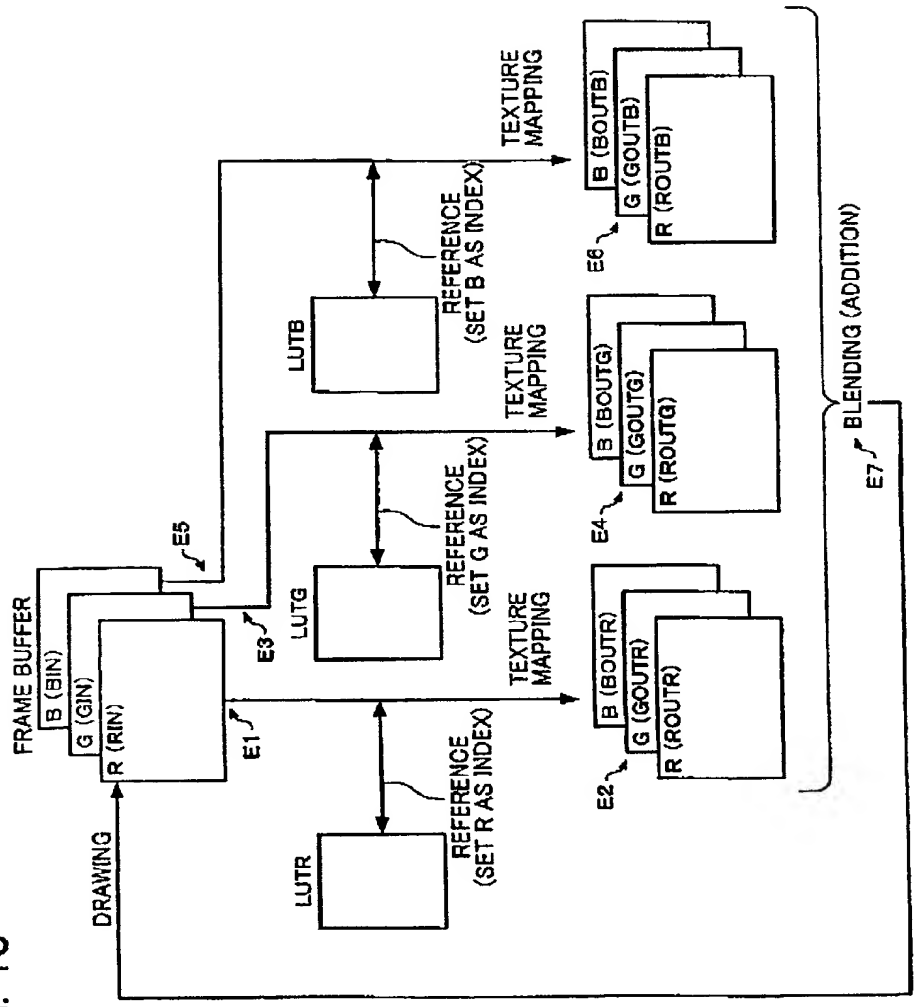
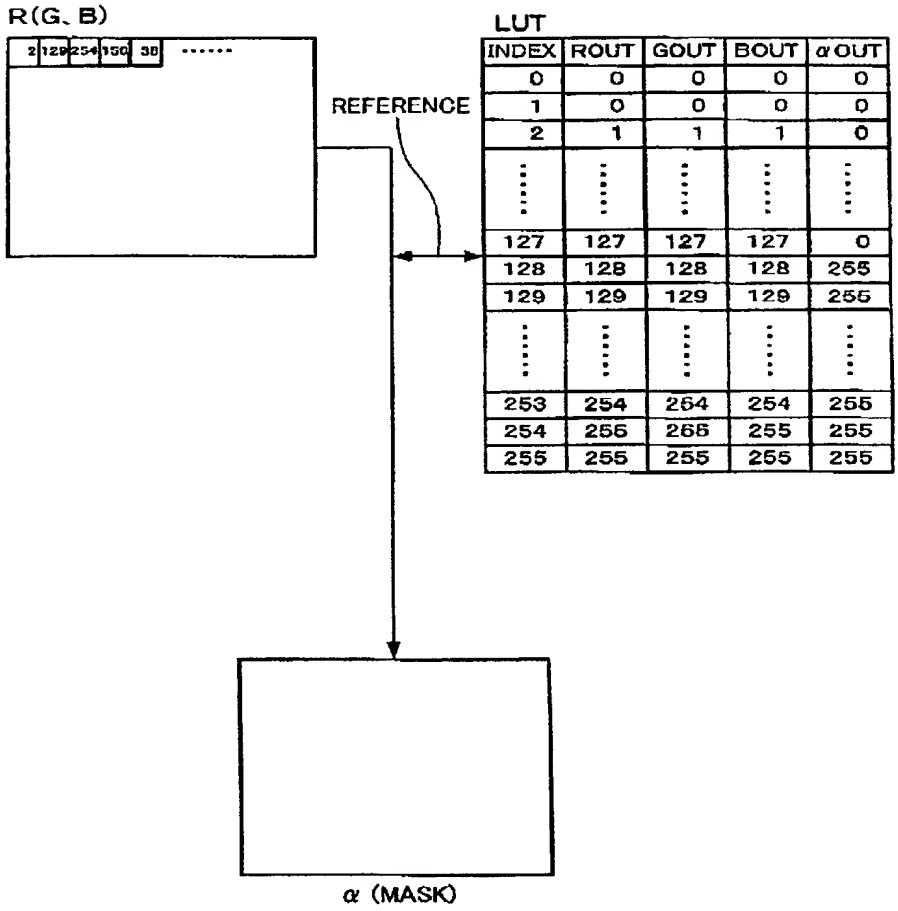

FRAME BUFFER
B (BIN)
G (GIN)
R (RIN)
DRAWING
E1
E2
E3
E4
E5
E6
E7
LUTR
LUTG
LUTB
REFERENCE (SET R AS INDEX)
REFERENCE (SET G AS INDEX)
REFERENCE (SET B AS INDEX)
TEXTURE MAPPING
TEXTURE MAPPING
TEXTURE MAPPING
B (BOUTR)
G (GOUTR)
R (ROUTR)
B (BOUTG)
G (GOUTG)
R (ROUTG)
B (BOUTB)
G (GOUTB)
R (ROUTB)
BLENDING (ADDITION)

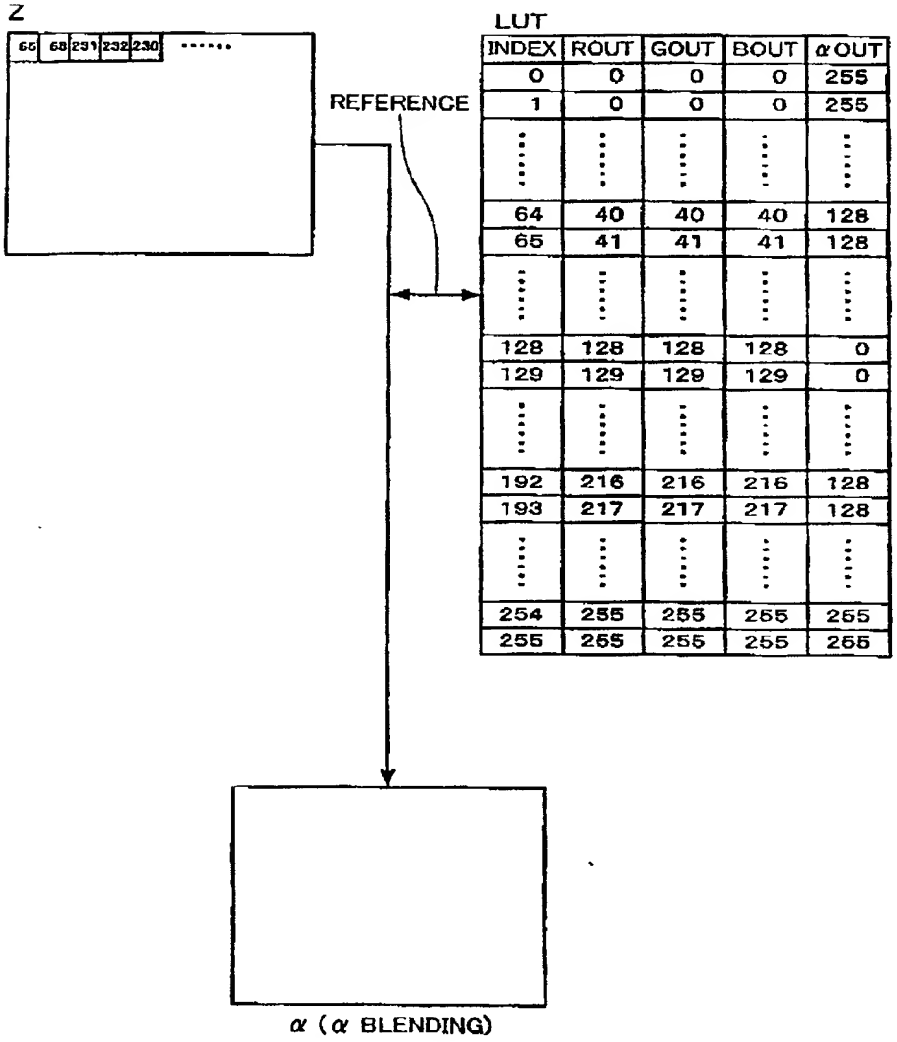
FIG. 14



LUT

INDEX	ROUT	GOUT	BOUT	αOUT
0	0	0	0	0
1	0	0	0	0
2	1	1	1	0
⋮	⋮	⋮	⋮	⋮
127	127	127	127	0
128	128	128	128	255
129	129	129	129	255
⋮	⋮	⋮	⋮	⋮
253	254	264	254	255
254	256	266	255	255
255	255	255	255	255

FIG. 15



INDEX	ROUT	GOUT	BOUT	αOUT
0	0	0	0	255
1	0	0	0	255
64	40	40	40	128
65	41	41	41	128
128	128	128	128	0
129	129	129	129	0
192	216	216	216	128
193	217	217	217	128
254	255	255	255	255
255	255	255	255	255

FIG. 16

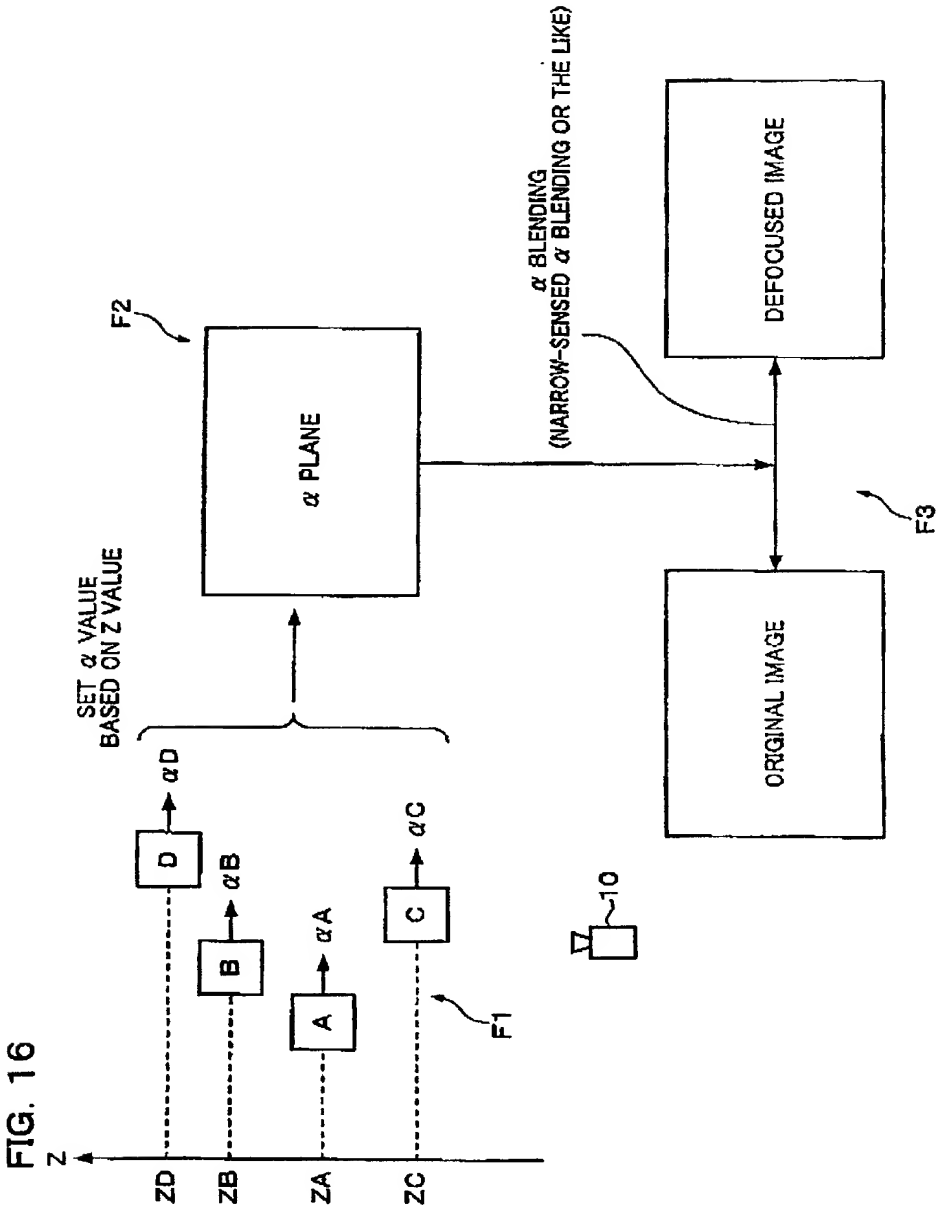

Z
ZD
ZB
ZA
ZC
D
B
A
C
αD
αB
αA
αC
F1
10
SET α VALUE BASED ON Z VALUE
F2
α PLANE
α BLENDING (NARROW-SENSED α BLENDING OR THE LIKE)
ORIGINAL IMAGE
DEFOCUSED IMAGE
F3

FIG. 17A ORIGINAL IMAGE

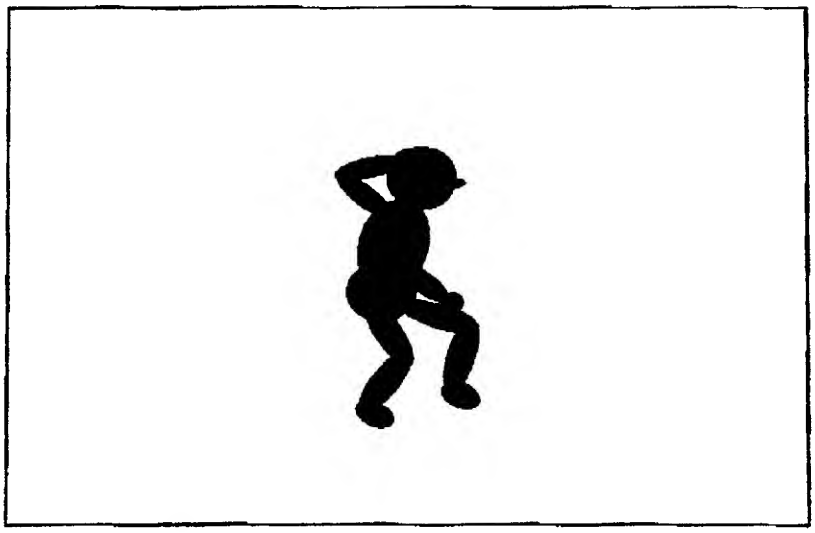


FIG. 17B DEFOCUSED IMAGE

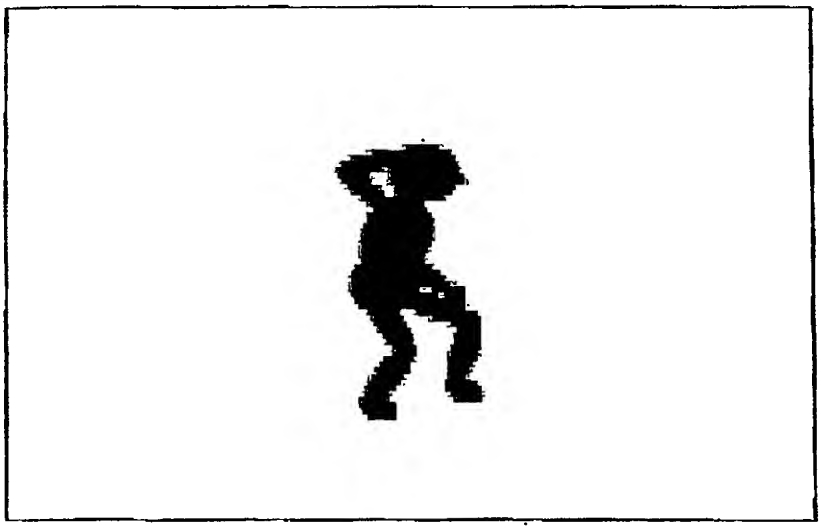
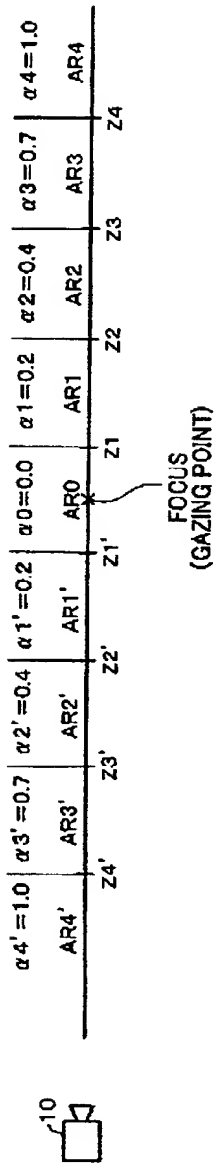


FIG. 18


α4=1.0
AR4
α3=0.7
AR3
α2=0.4
AR2
α1=0.2
AR1
α0=0.0
AR0
α1'=0.2
AR1'
α2'=0.4
AR2'
α3'=0.7
AR3'
α4'=1.0
AR4'
Z4
Z3
Z2
Z1
Z1'
Z2'
Z3'
Z4'
FOCUS
(GAZING POINT)
10

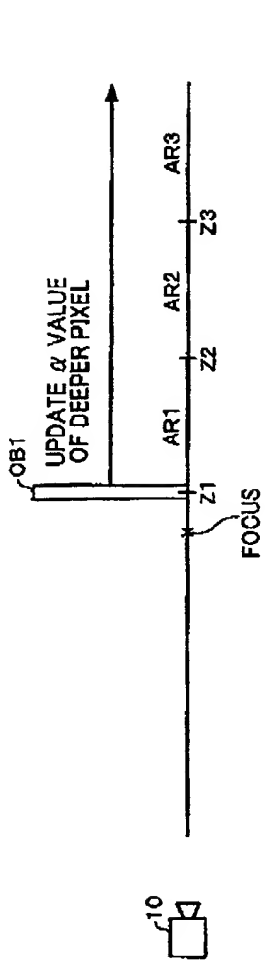


FIG. 19A

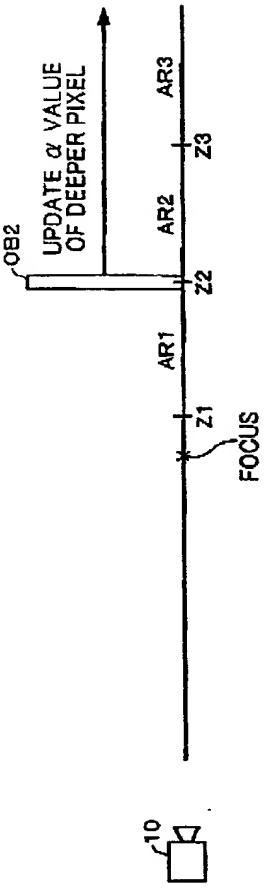


FIG. 19B

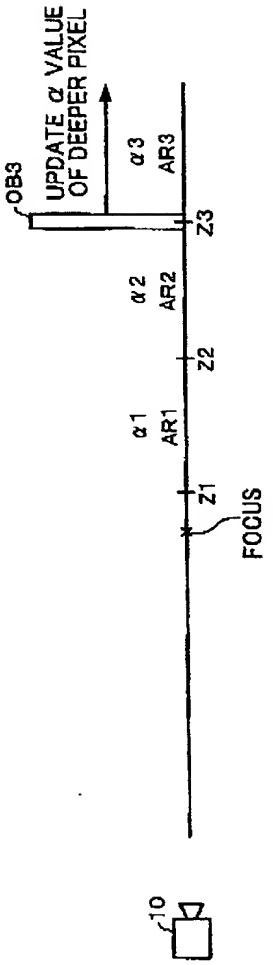
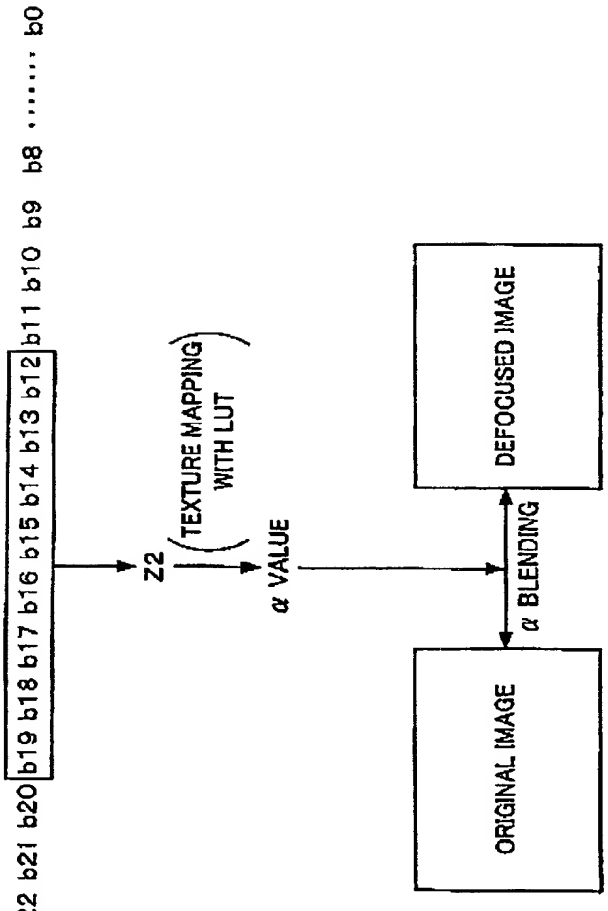


FIG. 19C

FIG. 20


Z = b23 b22 b21 b20 b19 b18 b17 b16 b15 b14 b13 b12 b11 b10 b9 b8 ..... b0
I
J
Z2
(TEXTURE MAPPING WITH LUT)
α VALUE
α BLENDING
ORIGINAL IMAGE
DEFOCUSED IMAGE

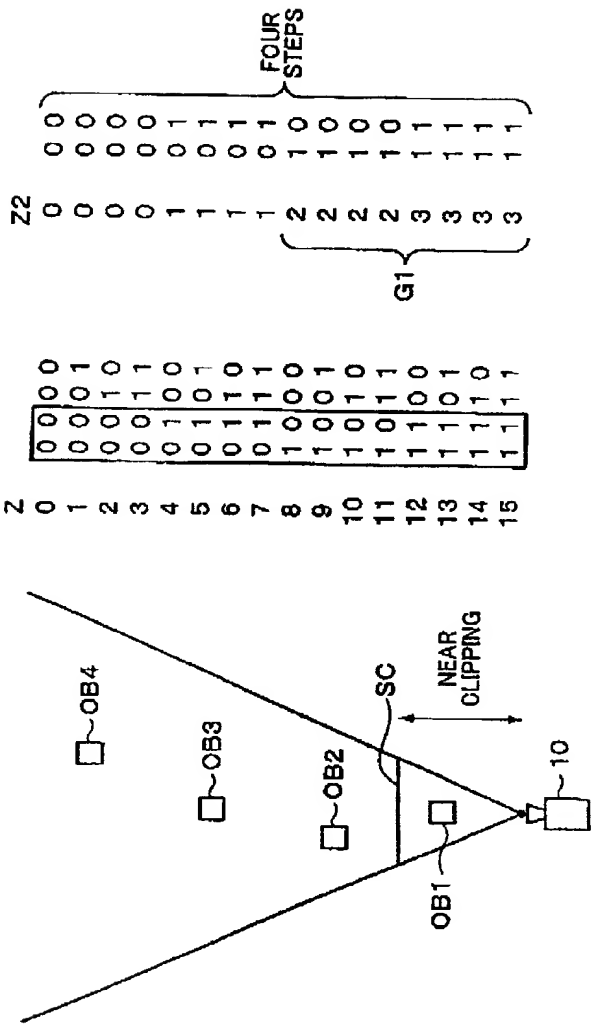
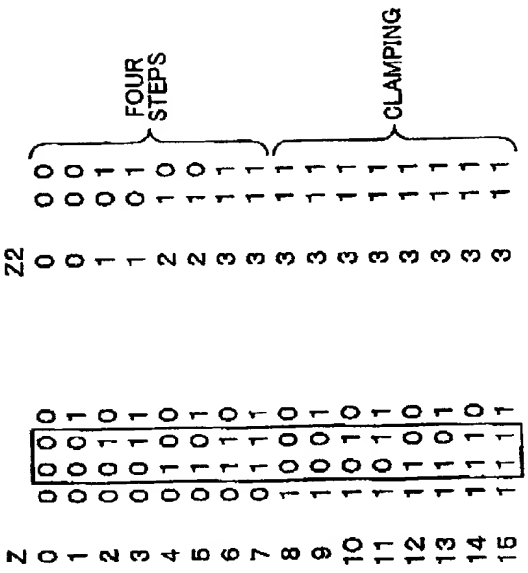


FIG. 21


FOUR STEPS
CLAMPING
Z2
0 0 1 1 2 2 3 3 3 3 3 3 3 3 3 3
0 0 0 1 0 1 1 0 1 1 1 1 1 1 1 1
0 0 1 0 1 1 0 0 1 1 1 1 1 1 1 1

Z
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1
0 0 0 0 1 1 1 1 0 0 0 0 1 1 1 1
0 0 1 1 0 0 1 1 0 0 1 1 0 0 1 1
0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1

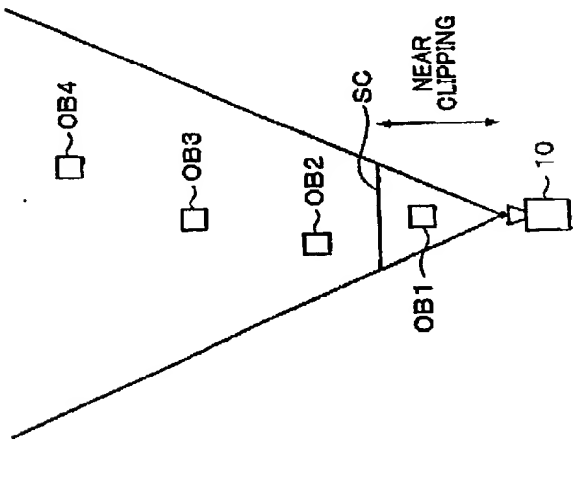

OB4
OB3
OB2
OB1
SC
NEAR CLIPPING
10

FIG. 22

FIG. 23

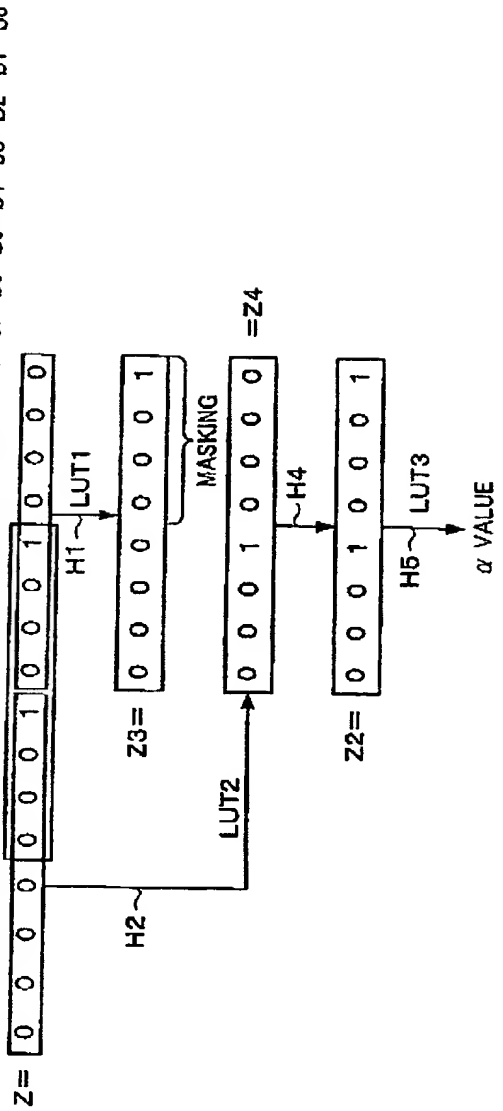

K
L
M
J
N
b23 b22 b21 b20 b19 b18 b17 b16 b15 b14 b13 b12 b11 b10 b9 b8 b7 b6 b5 b4 b3 b2 b1 b0
Z=
0 0 0 0 0 0 0 1 0 0 0 1 0 0 0 0
H1
LUT1
Z3=
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1
MASKING
=Z4
H2
LUT2
0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0
H4
Z2=
0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 1
H5
LUT3
α VALUE

FIG. 24

LUT1 (BITS 15 TO 8)

INDEX	OUT (ANY ONE OF R, G, B AND α)
0x00 (00000000)	0x00 (00000000)
⋮	⋮
0x0F (00001111)	0x00 (00000000)
0x10 (00010000)	0x01 (00000001)
⋮	⋮
0x1F (00011111)	0x01 (00000001)
0x20 (00100000)	0x02 (00000010)
⋮	⋮
0x2F (00101111)	0x02 (00000010)
0x30 (00110000)	0x03 (00000011)
⋮	⋮
0xE0 (11100000)	0x0E (00001110)
⋮	⋮
0xEF (11101111)	0x0E (00001110)
0xF0 (11110000)	0x0F (00001111)
0xF1 (11110001)	0x0F (00001111)
0xF2 (11110010)	0x0F (00001111)
⋮	⋮
0xFF (11111111)	0x0F (00001111)

FIG. 25

LUT2 (BITS 23 TO 16)

INDEX	OUT (ANY ONE OF R, G, B AND α)
0x00 (00000000)	0x00 (00000000)
0x01 (00000001)	0x10 (00010000)
0x02 (00000010)	0x20 (00100000)
0x03 (00000011)	0x30 (00110000)
0x04 (00000100)	0x40 (01000000)
⋮	⋮
0x0E (00001110)	0xE0 (11100000)
0x0F (00001111)	0xF0 (11110000)
0x10 (00010000)	0xF0 (11110000)
0x11 (00010001)	0xF0 (11110000)
⋮	⋮
0xFF (11111111)	0xF0 (11110000)

Q1

CLAMPING

FIG. 26A

LUT3

INDEX	OUT(α)
0x00 (00000000)	0xFF (11111111)
0x01 (00000001)	0xFE (11111110)
0x02 (00000010)	0xFB (11111011)
⋮	⋮
0x7F (01111111)	0x00 (00000000)
0x80 (10000000)	0x00 (00000000)
0x81 (10000001)	0x00 (00000000)
⋮	⋮
0xFE (11111110)	0xFE (11111110)
0xFF (11111111)	0xFF (11111111)

FIG. 26B

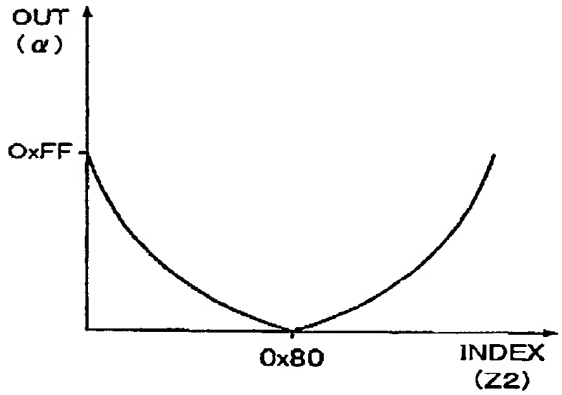


FIG. 27

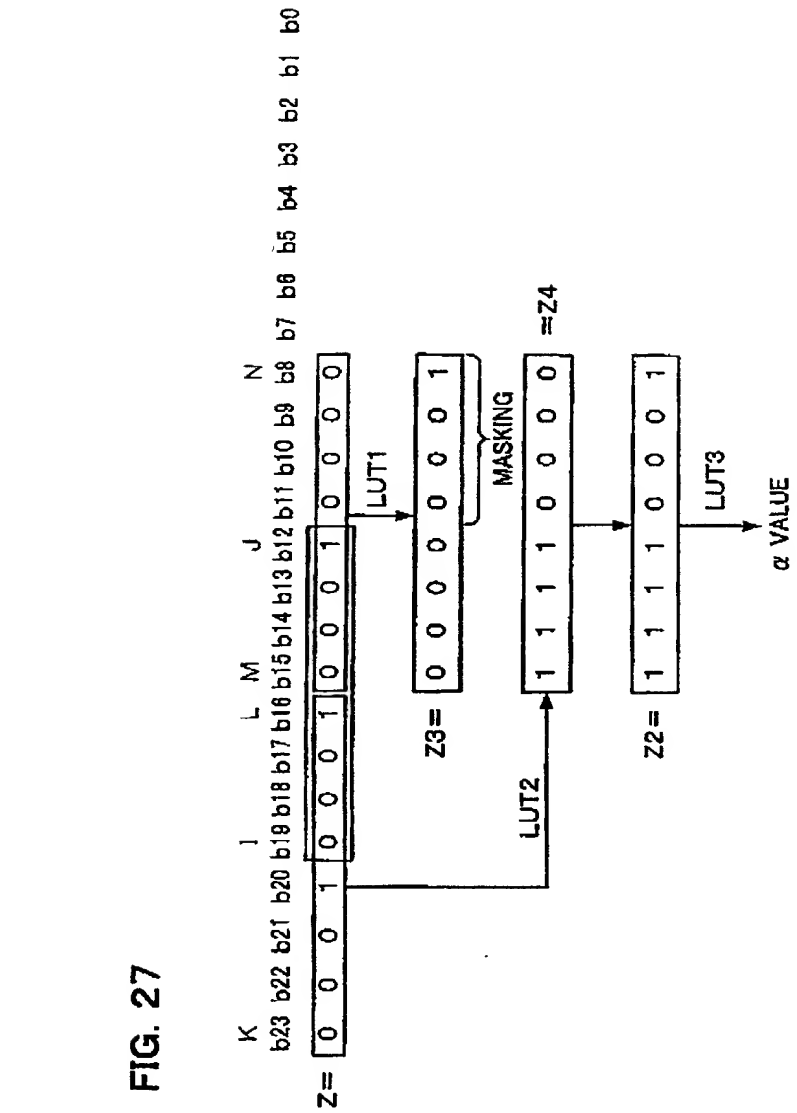
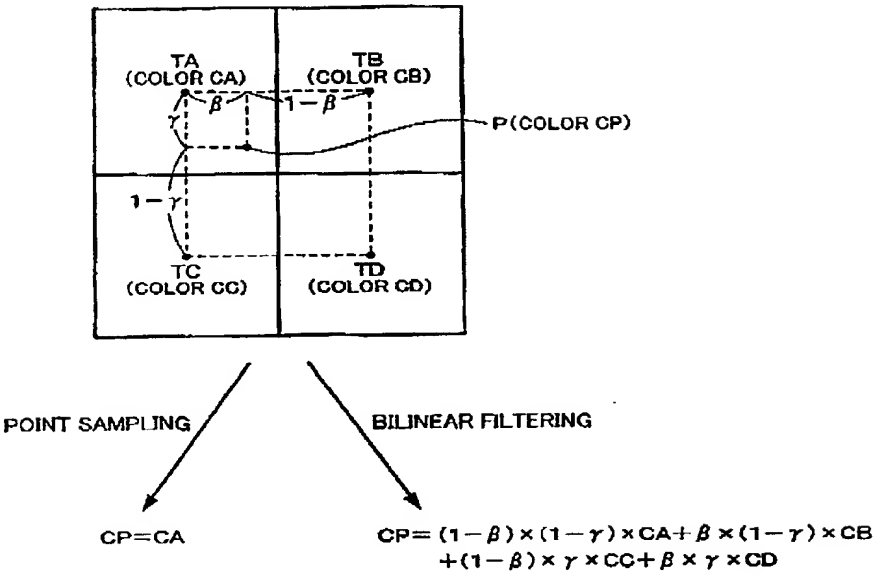

K
L
M
J
N
b23 b22 b21 b20 b19 b18 b17 b16 b15 b14 b13 b12 b11 b10 b9 b8 b7 b6 b5 b4 b3 b2 b1 b0
Z=
0 0 0 1 0 0 0 1 0 0 0 1 0 0 0 0
LUT1
Z3=
0 0 0 0 0 0 0 0 0 0 0 1
MASKING
=Z4
LUT2
1 1 1 1 1 0 0 0 0 0 0 0
Z2=
1 1 1 1 1 0 0 0 0 0 0 1
LUT3
α VALUE

FIG. 28



FOREIGN PUBLICATION

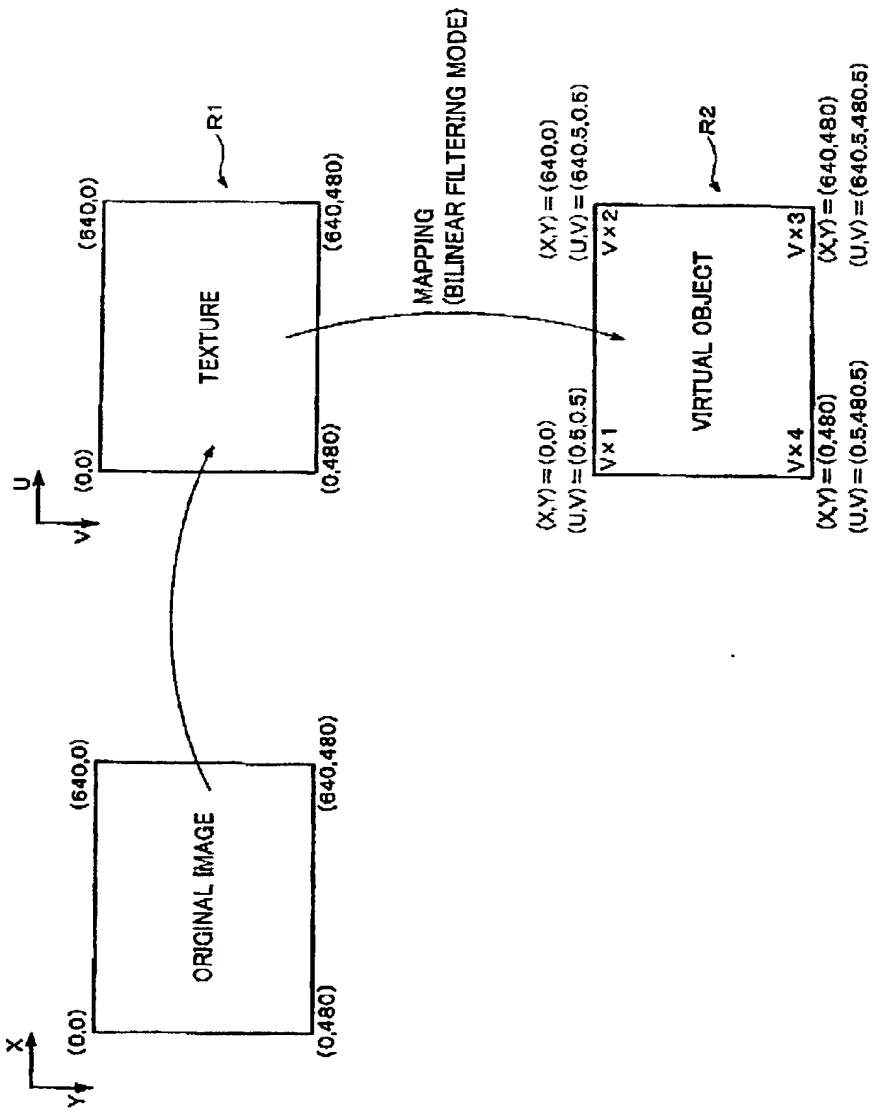

ORIGINAL IMAGE
(640,0)
(640,480)
(0,0)
(0,480)
X
Y
TEXTURE
R1
U
V
MAPPING
(BILINEAR FILTERING MODE)
VIRTUAL OBJECT
R2
V×1
V×2
V×3
V×4
(X,Y)=(0,0)
(U,V)=(0.5,0.5)
(X,Y)=(640,0)
(U,V)=(640.5,0.5)
(X,Y)=(0,480)
(U,V)=(0.5,480.5)
(X,Y)=(640,480)
(U,V)=(640.5,480.5)

FIG. 29

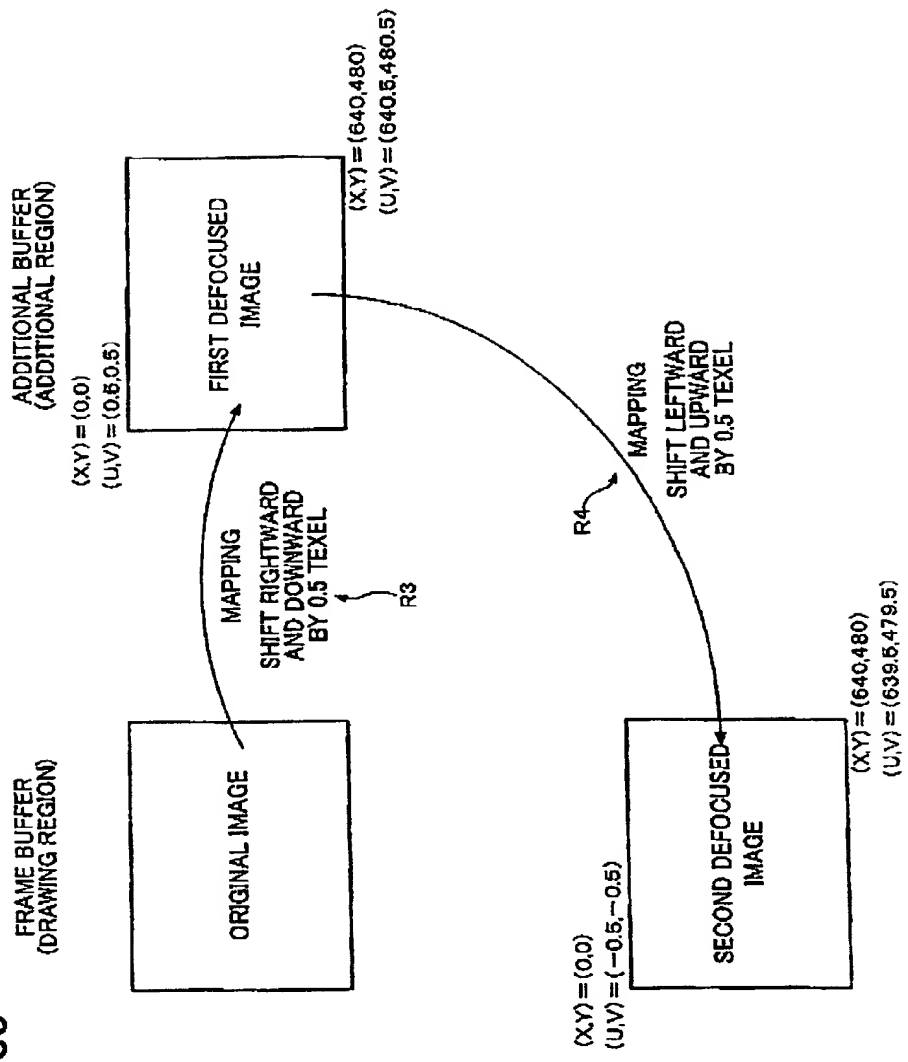

FRAME BUFFER
(DRAWING REGION)
ORIGINAL IMAGE
MAPPING
SHIFT RIGHTWARD
AND DOWNWARD
BY 0.5 TEXEL
R3
ADDITIONAL BUFFER
(ADDITIONAL REGION)
(X,Y) = (0,0)
(U,V) = (0.5,0.5)
FIRST DEFOCUSED
IMAGE
(X,Y) = (640,480)
(U,V) = (640.5,480.5)
R4
MAPPING
SHIFT LEFTWARD
AND UPWARD
BY 0.5 TEXEL
(X,Y) = (0,0)
(U,V) = (−0.5,−0.5)
SECOND DEFOCUSED
IMAGE
(X,Y) = (640,480)
(U,V) = (639.5,479.5)

FIG. 30

FIG. 31A

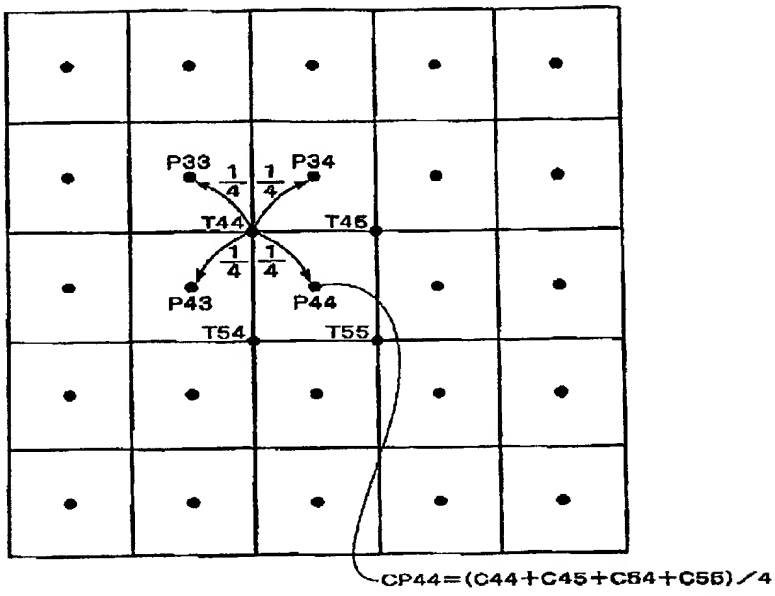


FIG. 31B

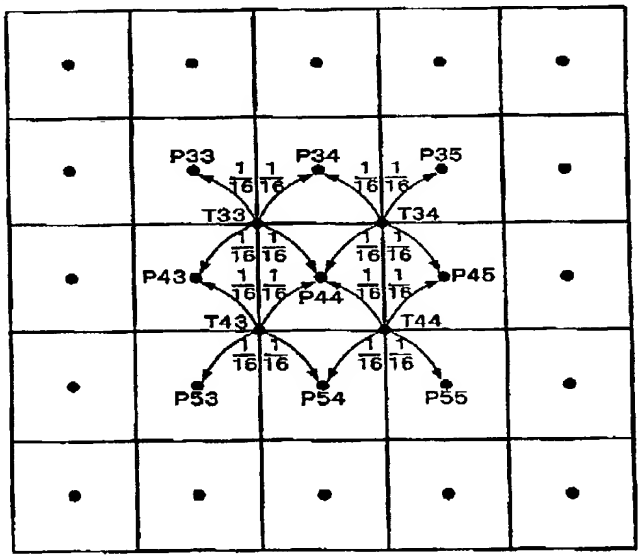


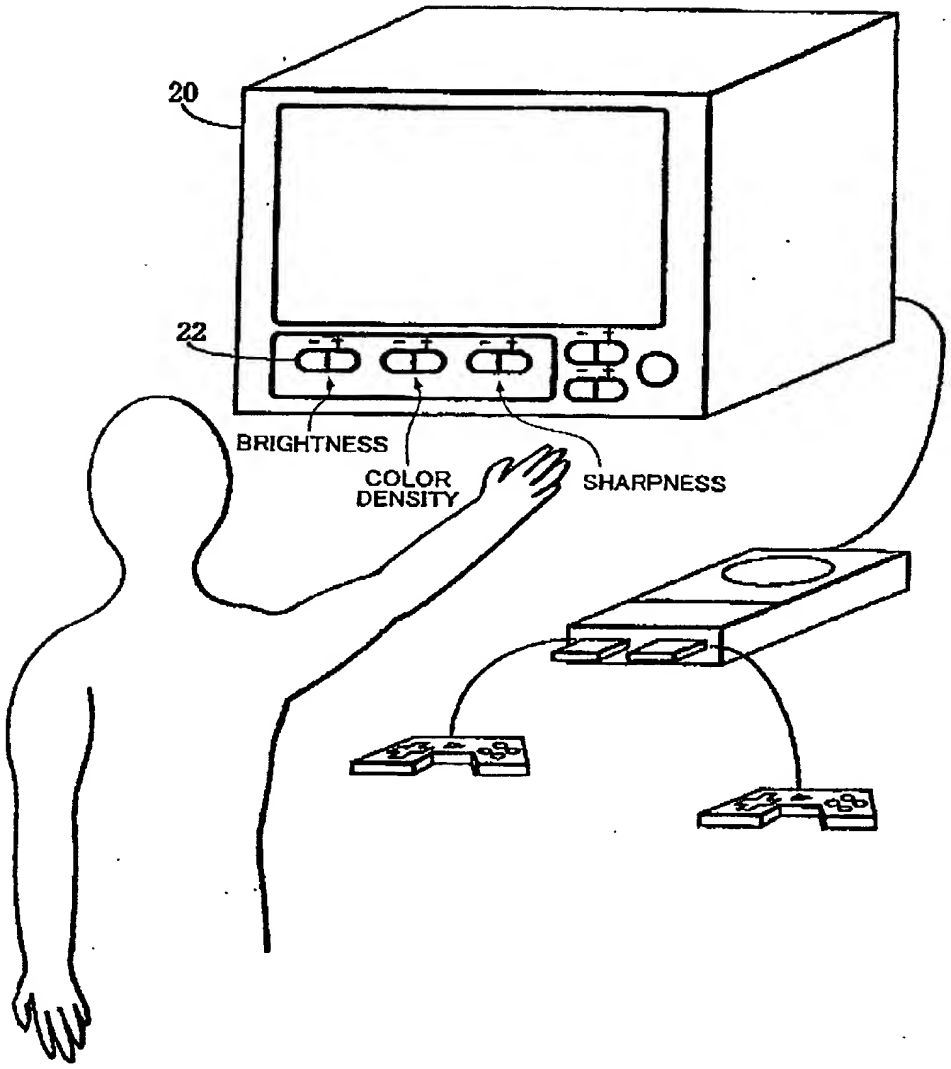
FIG. 32A

	$\frac{1}{16}$	$\frac{2}{16}$	$\frac{1}{16}$	
	$\frac{2}{16}$	$\frac{4}{16}$	$\frac{2}{16}$	
	$\frac{1}{16}$	$\frac{2}{16}$	$\frac{1}{16}$	

FIG. 32B

$\frac{1}{256}$	$\frac{4}{256}$	$\frac{6}{256}$	$\frac{4}{256}$	$\frac{1}{256}$
$\frac{4}{256}$	$\frac{16}{256}$	$\frac{24}{256}$	$\frac{16}{256}$	$\frac{4}{256}$
$\frac{6}{256}$	$\frac{24}{256}$	$\frac{36}{256}$	$\frac{24}{256}$	$\frac{6}{256}$
$\frac{4}{256}$	$\frac{16}{256}$	$\frac{24}{256}$	$\frac{16}{256}$	$\frac{4}{256}$
$\frac{1}{256}$	$\frac{4}{256}$	$\frac{6}{256}$	$\frac{4}{256}$	$\frac{1}{256}$

FIG. 33



JP03TOT 020326A1

FIG. 34

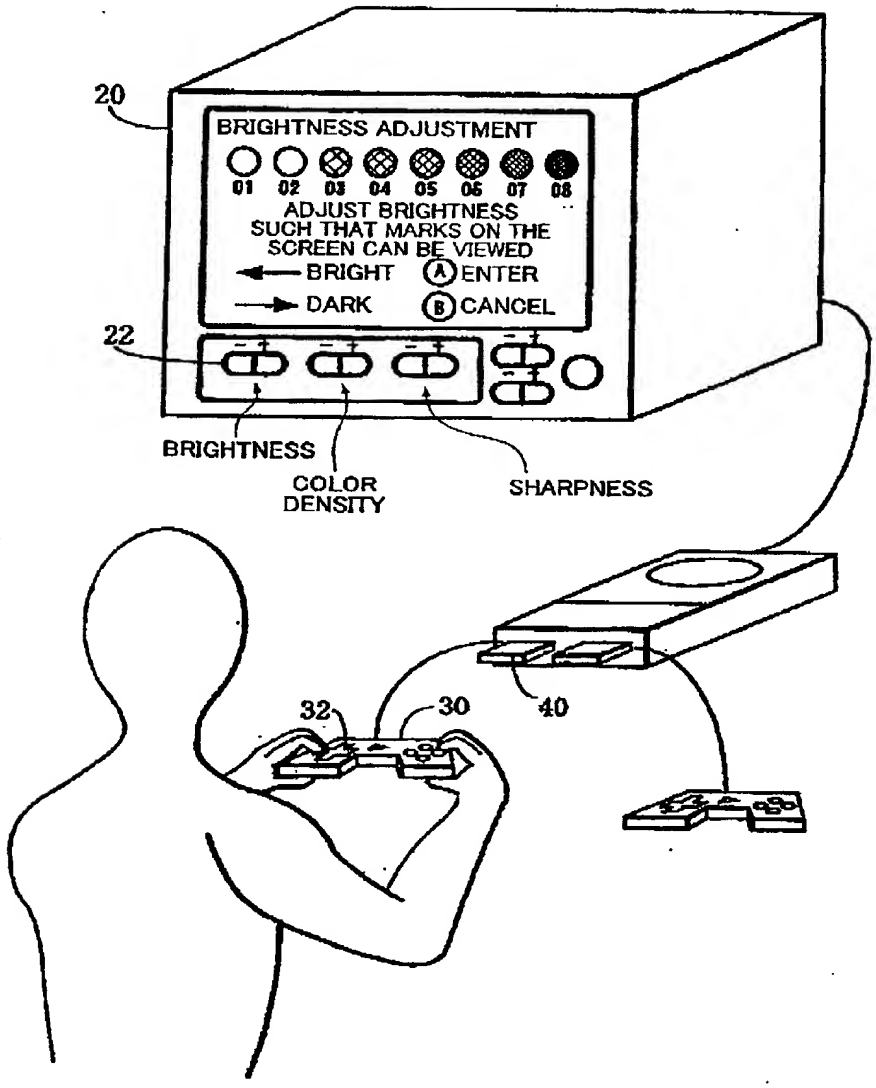
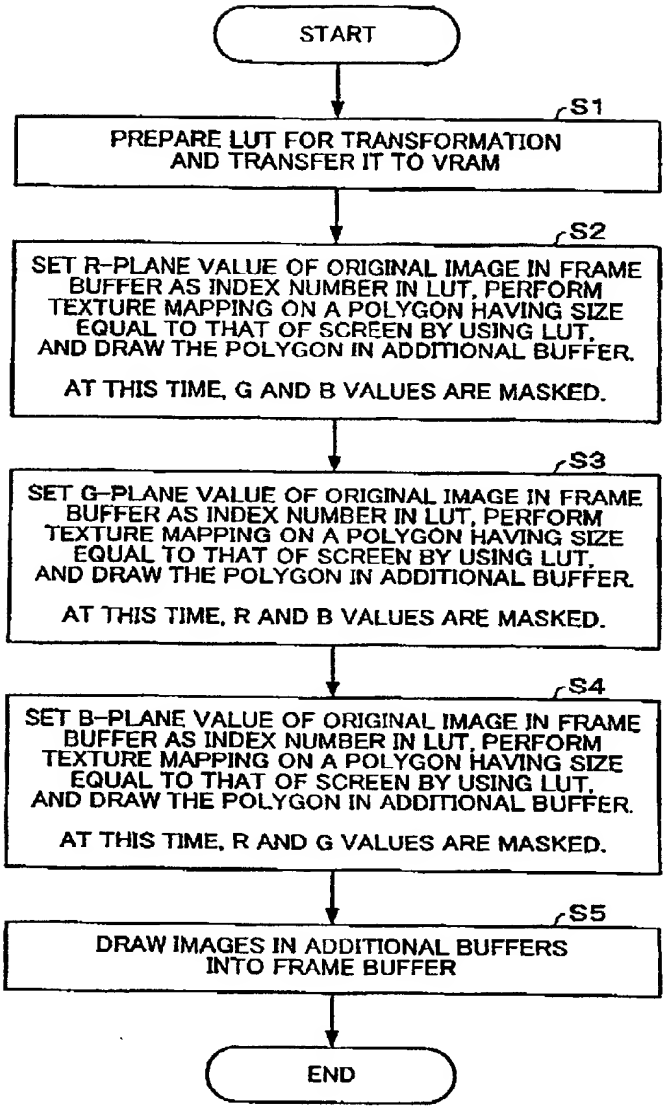

20
BRIGHTNESS ADJUSTMENT
01 02 03 04 05 06 07 08
ADJUST BRIGHTNESS SUCH THAT MARKS ON THE SCREEN CAN BE VIEWED
BRIGHT
DARK
A ENTER
B CANCEL
22
BRIGHTNESS
COLOR DENSITY
SHARPNESS
32
30
40

FIG. 35



JP2001-229350

FIG. 36

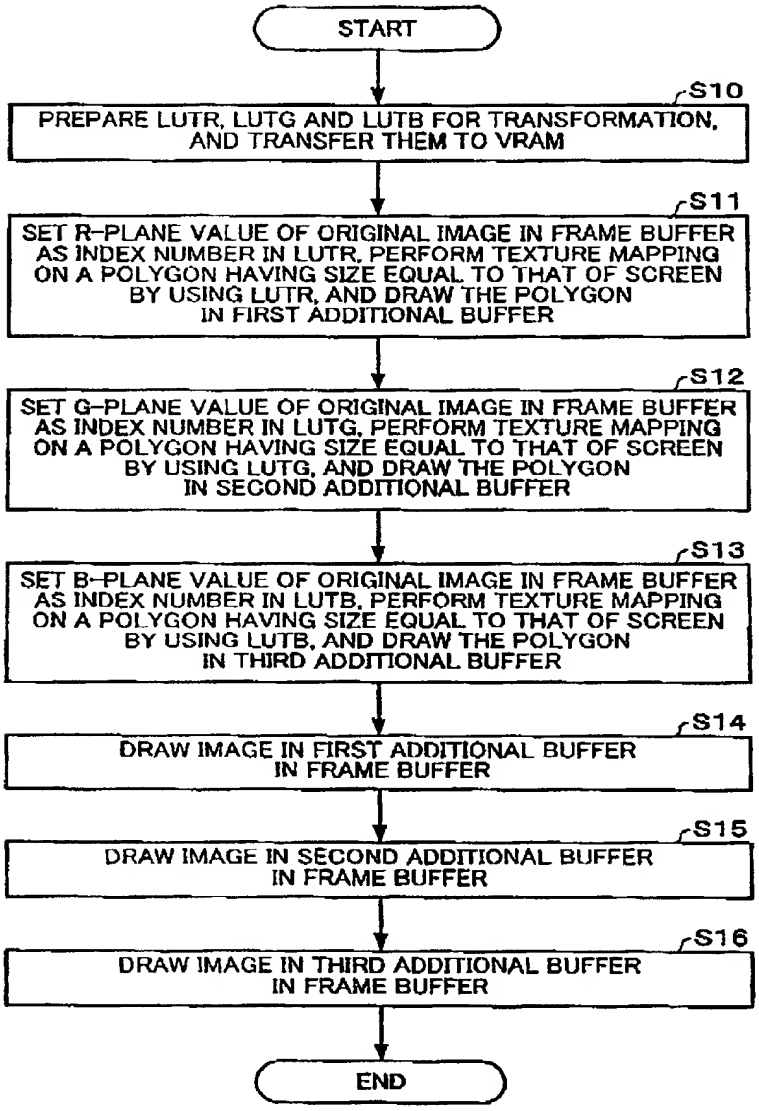

START
S10
PREPARE LUTR, LUTG AND LUTB FOR TRANSFORMATION, AND TRANSFER THEM TO VRAM
S11
SET R-PLANE VALUE OF ORIGINAL IMAGE IN FRAME BUFFER AS INDEX NUMBER IN LUTR, PERFORM TEXTURE MAPPING ON A POLYGON HAVING SIZE EQUAL TO THAT OF SCREEN BY USING LUTR, AND DRAW THE POLYGON IN FIRST ADDITIONAL BUFFER
S12
SET G-PLANE VALUE OF ORIGINAL IMAGE IN FRAME BUFFER AS INDEX NUMBER IN LUTG, PERFORM TEXTURE MAPPING ON A POLYGON HAVING SIZE EQUAL TO THAT OF SCREEN BY USING LUTG, AND DRAW THE POLYGON IN SECOND ADDITIONAL BUFFER
S13
SET B-PLANE VALUE OF ORIGINAL IMAGE IN FRAME BUFFER AS INDEX NUMBER IN LUTB, PERFORM TEXTURE MAPPING ON A POLYGON HAVING SIZE EQUAL TO THAT OF SCREEN BY USING LUTB, AND DRAW THE POLYGON IN THIRD ADDITIONAL BUFFER
S14
DRAW IMAGE IN FIRST ADDITIONAL BUFFER IN FRAME BUFFER
S15
DRAW IMAGE IN SECOND ADDITIONAL BUFFER IN FRAME BUFFER
S16
DRAW IMAGE IN THIRD ADDITIONAL BUFFER IN FRAME BUFFER
END

FIG. 37

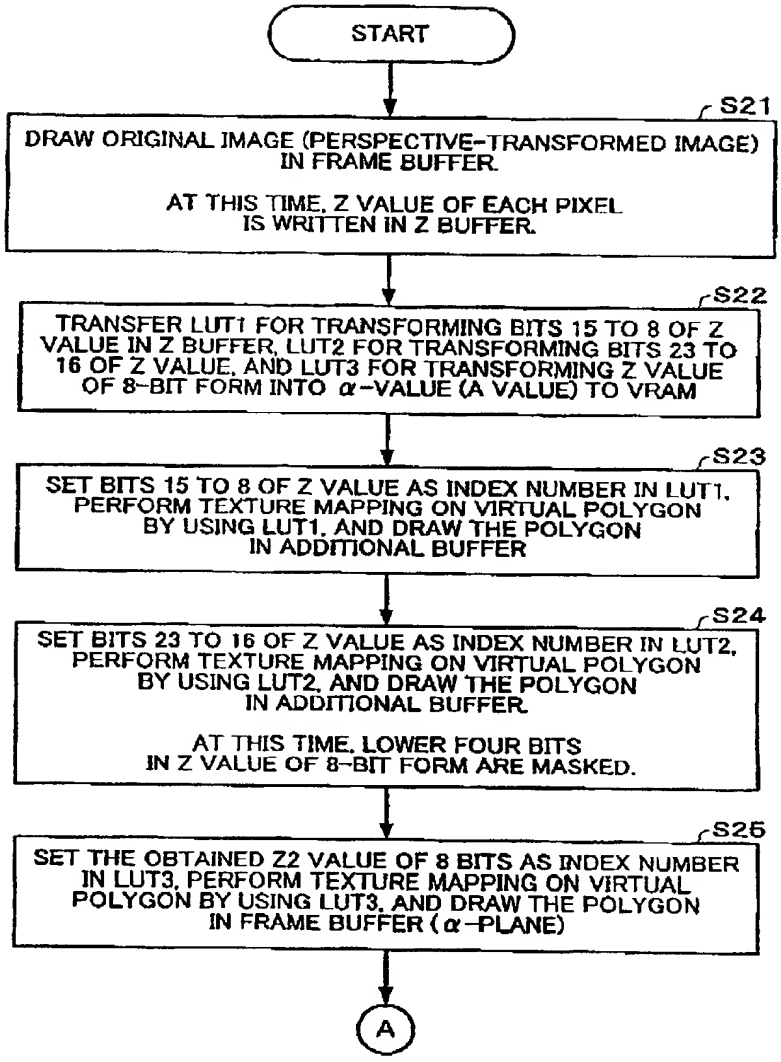

START
S21
DRAW ORIGINAL IMAGE (PERSPECTIVE-TRANSFORMED IMAGE) IN FRAME BUFFER.
AT THIS TIME, Z VALUE OF EACH PIXEL IS WRITTEN IN Z BUFFER.
S22
TRANSFER LUT1 FOR TRANSFORMING BITS 15 TO 8 OF Z VALUE IN Z BUFFER, LUT2 FOR TRANSFORMING BITS 23 TO 16 OF Z VALUE, AND LUT3 FOR TRANSFORMING Z VALUE OF 8-BIT FORM INTO α-VALUE (A VALUE) TO VRAM
S23
SET BITS 15 TO 8 OF Z VALUE AS INDEX NUMBER IN LUT1, PERFORM TEXTURE MAPPING ON VIRTUAL POLYGON BY USING LUT1, AND DRAW THE POLYGON IN ADDITIONAL BUFFER
S24
SET BITS 23 TO 16 OF Z VALUE AS INDEX NUMBER IN LUT2, PERFORM TEXTURE MAPPING ON VIRTUAL POLYGON BY USING LUT2, AND DRAW THE POLYGON IN ADDITIONAL BUFFER.
AT THIS TIME, LOWER FOUR BITS IN Z VALUE OF 8-BIT FORM ARE MASKED.
S25
SET THE OBTAINED Z2 VALUE OF 8 BITS AS INDEX NUMBER IN LUT3, PERFORM TEXTURE MAPPING ON VIRTUAL POLYGON BY USING LUT3, AND DRAW THE POLYGON IN FRAME BUFFER (α-PLANE)
A

FIG. 38

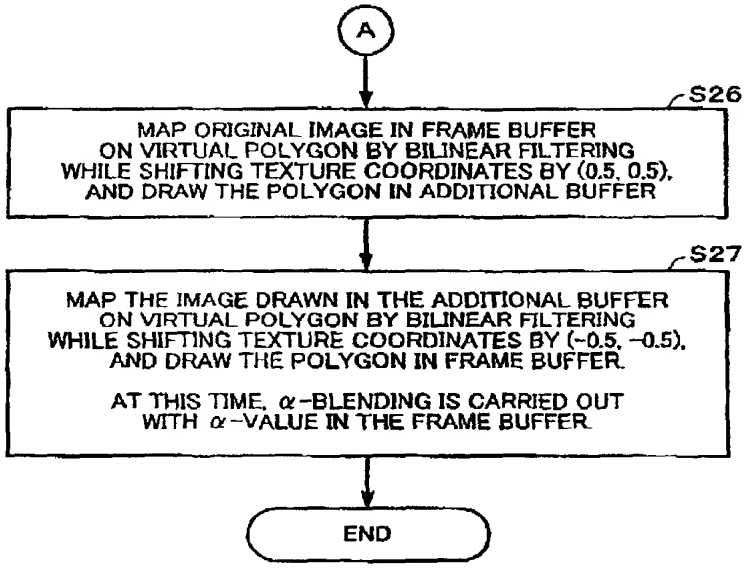
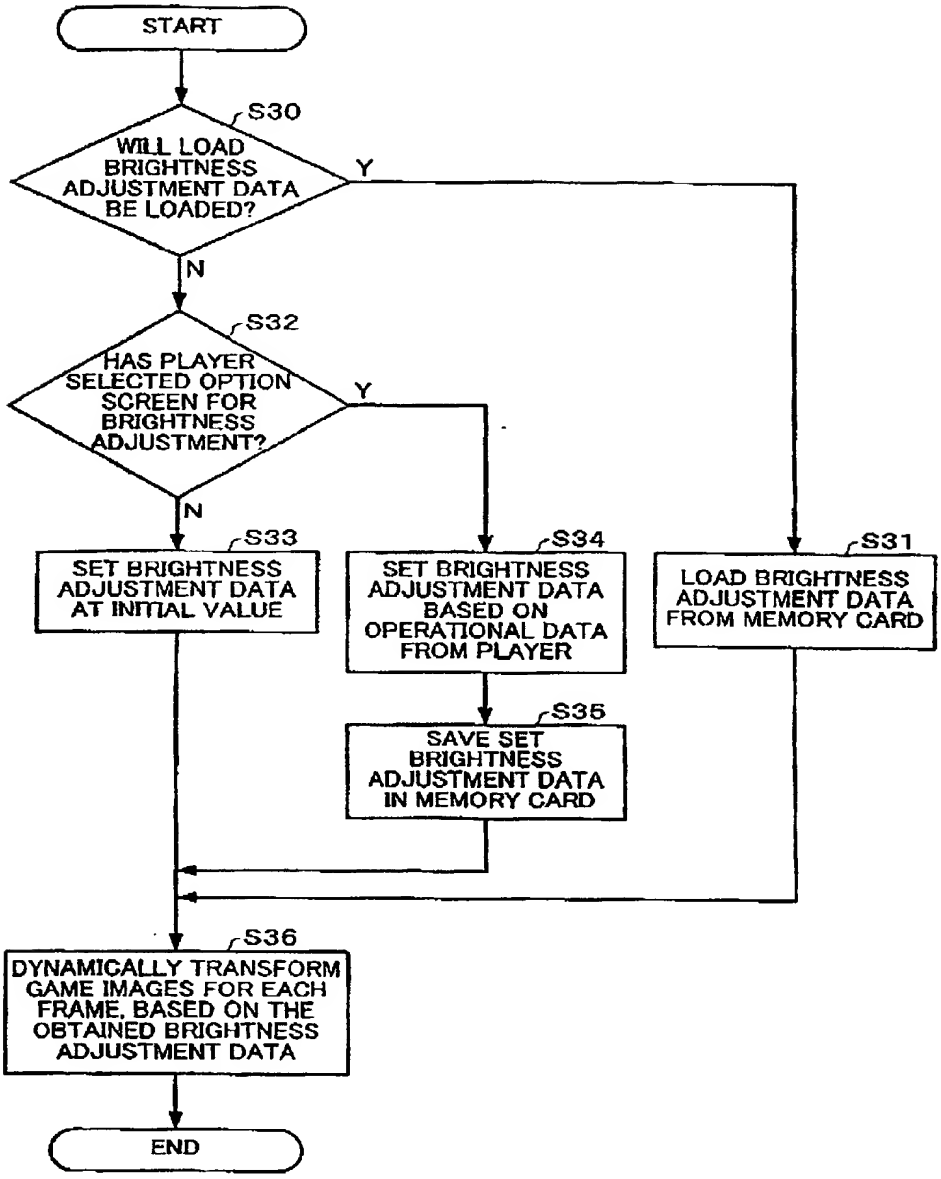

A
S26
MAP ORIGINAL IMAGE IN FRAME BUFFER ON VIRTUAL POLYGON BY BILINEAR FILTERING WHILE SHIFTING TEXTURE COORDINATES BY (0.5, 0.5), AND DRAW THE POLYGON IN ADDITIONAL BUFFER
S27
MAP THE IMAGE DRAWN IN THE ADDITIONAL BUFFER ON VIRTUAL POLYGON BY BILINEAR FILTERING WHILE SHIFTING TEXTURE COORDINATES BY (-0.5, -0.5), AND DRAW THE POLYGON IN FRAME BUFFER.
AT THIS TIME, α-BLENDING IS CARRIED OUT WITH α-VALUE IN THE FRAME BUFFER.
END

FIG. 39


START
S30
WILL LOAD BRIGHTNESS ADJUSTMENT DATA BE LOADED?
Y
N
S32
HAS PLAYER SELECTED OPTION SCREEN FOR BRIGHTNESS ADJUSTMENT?
Y
N
S33
SET BRIGHTNESS ADJUSTMENT DATA AT INITIAL VALUE
S34
SET BRIGHTNESS ADJUSTMENT DATA BASED ON OPERATIONAL DATA FROM PLAYER
S35
SAVE SET BRIGHTNESS ADJUSTMENT DATA IN MEMORY CARD
S31
LOAD BRIGHTNESS ADJUSTMENT DATA FROM MEMORY CARD
S36
DYNAMICALLY TRANSFORM GAME IMAGES FOR EACH FRAME, BASED ON THE OBTAINED BRIGHTNESS ADJUSTMENT DATA
END

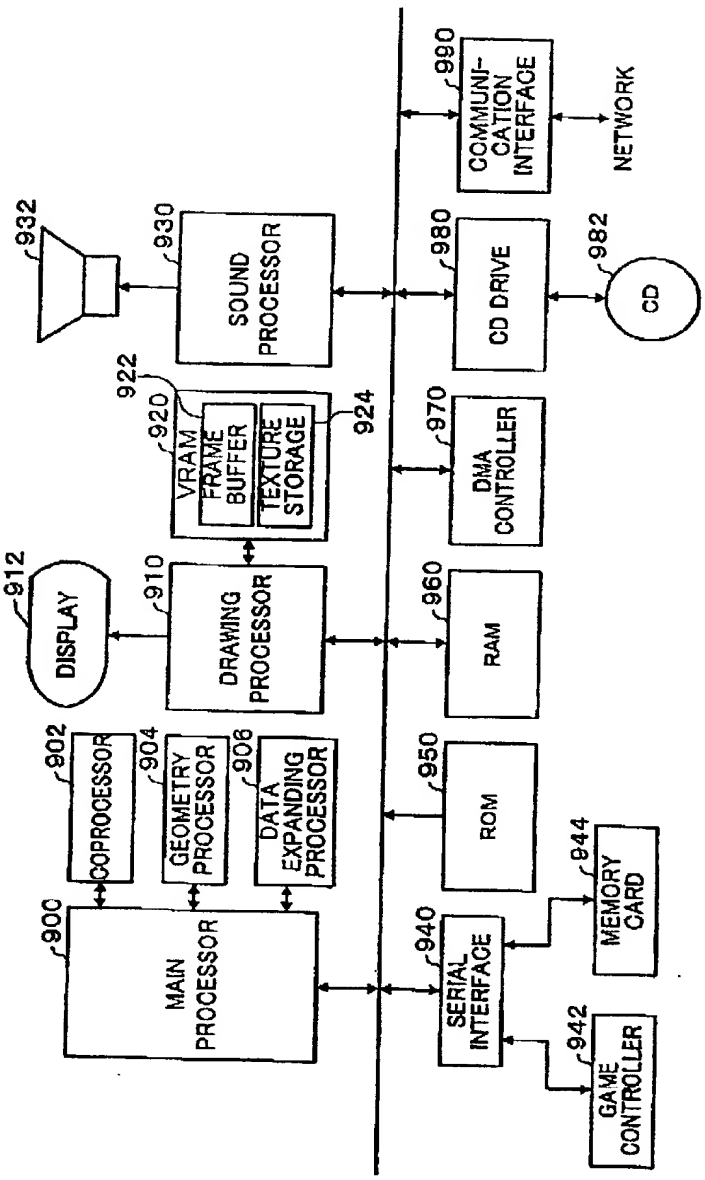

MAIN PROCESSOR
900
COPROCESSOR
902
GEOMETRY PROCESSOR
904
DATA EXPANDING PROCESSOR
906
DISPLAY
912
DRAWING PROCESSOR
910
VRAM
920
FRAME BUFFER
TEXTURE STORAGE
922
924
932
SOUND PROCESSOR
930
ROM
950
RAM
960
DMA CONTROLLER
970
SERIAL INTERFACE
940
MEMORY CARD
844
GAME CONTROLLER
942
CD DRIVE
980
CD
982
COMMUNI-CATION INTERFACE
990
NETWORK

FIG. 40

FIG. 41A

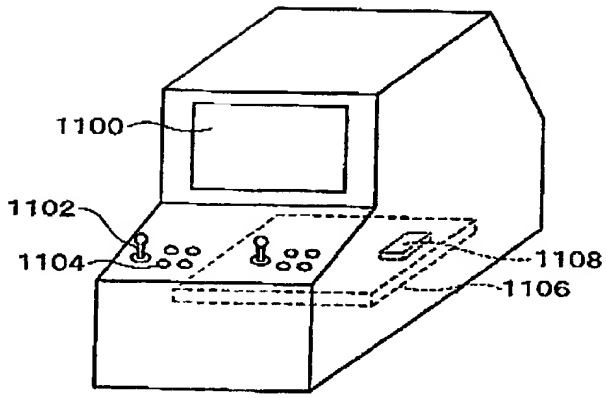


FIG. 41B

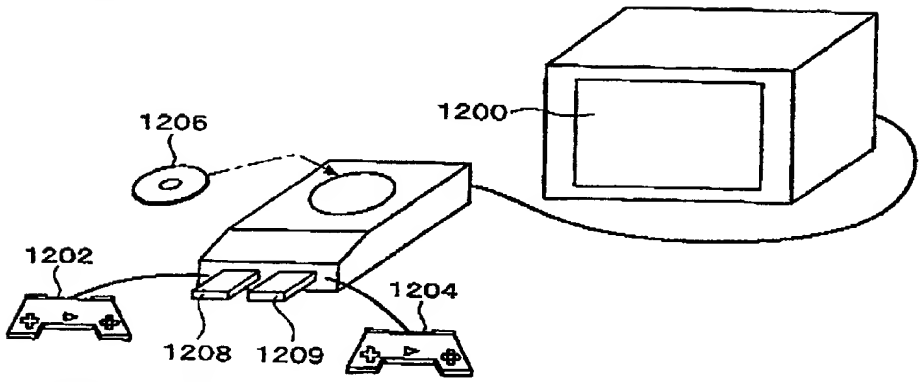
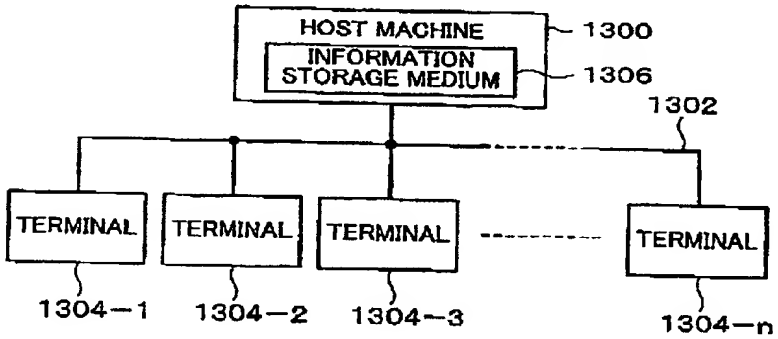



FIG. 41C